10.0 SNAKE RIVER SPRING/SUMMER CHINOOK

10.1 BACKGROUND

10.1.1 Description of the ESU

The ESU includes all naturally spawned populations and certain hatchery produced components of spring/summer chinook salmon in the mainstem Snake River, Tucannon River, Grande Ronde River, Imnaha River, and Salmon River. The Interior Columbia Technical Review Team has identified 31 extant populations with the ESU (Table 10.1)**.** There are 15 hatchery programs associated with these populations, 14 of which are included in the ESU (Table 10.2)**.** Historically this ESU may have also included populations of spring/summer chinook salmon originating upstream of the Hells Canyon Hydroelectric Dam Complex on the Snake River. Both hatchery and naturally produced spring/summer chinook salmon returning to the Clearwater River are not part of the ESU, because native stocks were extirpated by dams and the current populations were reintroduced after the dams were breached (Matthews and Waples 1991).

Table 10.1. List of independent spring/summer chinook populations identified by the TRT in the Snake River ESU.

1 -Tucannon River (SNTUC)[1]	17 - Camas Creek (MFCAM)
2 - Asotin Creek (SNASO)[4]	18 - Loon Creek (MFLOO)
3 - Wenaha River (GRWEN)	19 - Pistol Creek (MFPIS)
4 - Lostine River (GRLOW)[1]	20 - Sulphur Creek (MFSUL))
5 - Minam River (GRMIN)	21 - Bear Valley Creek (MFBEA)
6 - Catherine Creek (GRCAT)[1]	22 - Marsh Creek (MFMAR)
7 - Grande Ronde Upper Main Stem [1] (GRUMA)	23 - Middle Fork above Indian Cr. (MFUMA)
8 - Imnaha [1]	24 - North Fork Salmon (SRNFS)
9 - Big Sheep Creek (IRBSC)[1],[4]	25 - Lemhi River (SRLEM)[2]
10 - Little Salmon River(SRLSR)[3]	26 - Pahsimeroi River (SRPAH)[1]
11 - South Fork Salmon River Main Stem [1] (SFMAI)	27 - Salmon River below Redfish Lake (SRLMA)
12 - Secesh River (SFSEC)	28 - East Fork Salmon (SREFS)[2]
13 - East Fork South Fork (SFEFS)[1]	29 - Yankee Fork (SRYFS)[2]
14 - Chamberlain Creek (SRCHA)	30 - Valley Creek (SRVAL)
15 - Big Creek (MFBIG)	31 - Salmon River, upper Main Stem (SRUMA)[1]
16 - Middle Fork below Indian (MFLMA)	

[1] Population is affected by an associated, integrated artificial propagation program.
[2] Population is affected by a captive propagation experiment.
[3] Population is affected by an isolated propagation program.
[4] Asotin Creek was thought to be extinct in the mid 1990s, Big Sheep Creek has become heavily influenced by the Imnaha hatchery program.

Table 10.2. Artificial Propagation Programs that release fish within the geographical boundaries of the Snake River Spring/summer Chinook ESU. Numbering corresponds to TRT identified populations.

Population/Program	**Type**	**Included in ESU?**	**Description**	**Size**	**Year Initiated**
1 -Tucannon River (SNTUC)					
Tucannon River Conventional	Integrated	Yes	Yearling Smolts	132,000	1985
Tucannon River Captive Brood	Integrated	Yes	Yearling Smolts	150,000	1997
4 - Lostine River (GRLOS)					
Lostine River Captive/Conventional	Integrated	Yes	Yearling Smolts	250,000	1995
6 - Catherine Creek (GRCAT)					
Catherine Creek Captive/Conventional	Integrated	Yes	Yearling Smolts	250,000	1995
Lookingglass Creek					
Lookingglass reintroduction (Catherine Creek Stock)	Integrated	Yes	Yearling Smolts	150,000	2002
7 - Grande Ronde Upper Main Stem (GRUMA)					
Upper Grande Ronde Captive/Conventional	Integrated	Yes	Yearling Smolts	250,000	1995
8 - Imnaha River					
Imnaha Chinook	Integrated	Yes	Yearling Smolts	360,000	1982
9 - Big Sheep Creek (IRBSC)					
Imnaha Chinook	Integrated	Yes	Adults1	150 pairs	1997
10 - Little Salmon River (SRLSR)					
Rapid River Spring Chinook	Isolated	No	Yearling Smolts	3,000,000	1964
11 - South Fork Salmon River Main Stem (SFMAI)					
South Fork Summer Chinook (McCall hatchery)	Integrated	Yes	Yearling Smolts1	1,000,000	1974
13 - East Fork South Fork (SFEFS)					
Johnson Creek Artificial Propagation Enhancement (JCAPE)	Integrated	Yes	Yearling Smolts1	100,000	1997
25 - Lemhi River (SRLEM)					
Lemhi River Captive Rearing Experiment	Integrated	Yes	Adult	<20 pairs	1997
26 - Pahsimeroi River (SRPAH)					
Pahsimeroi Summer Chinook	Integrated	Yes	Yearling Smolts	1,000,000	1980
28 East Fork Salmon (SREFS)					
East Fork Captive Rearing Experiment	Integrated	Yes	Adult	<20 pairs	1997
29 - Yankee Fork (SRYFS)					
Yankee Fork Captive Rearing Experiment	Integrated	Yes	Adult	<20 pairs	1997
31 - Salmon River, upper Main Stem (SRUMA)					
Sawtooth Hatchery Spring Chinook	Integrated	Yes	Yearling Smolts	1,300,000	1985
[1] Other life stages including eyed eggs, parr, smolts or adults may be released.					

10.1.2 Status of the ESU

The 1991 Snake River spring/summer chinook salmon status review (Mathews and Waples, 1991) concluded that the ESU was at risk based on a set of key factors. Aggregate abundance of naturally produced Snake River spring/summer chinook salmon runs had dropped to a small fraction of historical levels. Short-term projections at the time (including jack counts, habitat/flow conditions in the brood years producing the next generation of returns) were for a continued downward trend in abundance. Risk modeling indicated that if the historical trend in abundance continued, the ESU as a whole was at risk of extinction within 100 years. The review identified similar concerns with individual populations within the ESU due to low abundance levels and risks to individual subpopulations being greater than the extinction risk for the ESU as a whole. The Snake River spring/summer chinook salmon, *Oncorhynchus tshawytscha*, was listed as threatened, April 22, 1992.

The 1998 Snake River spring/summer chinook salmon status review (Myers *et al.* 1998) summarized population trends, updated information, and concluded that the status of this ESU had not improved since the 1991 review. The review showed an ESU in both a short and long-term downward trend in abundance. The report identified continuing disruption due to the impact of mainstem hydroelectric development including altered flow regimes and impacts on estuarine habitats. The 1998 review also identified regional habitat degradation and risks associated with the use of hatchery stocks in particular areas. Use of non local hatchery stocks in the Grande Ronde River basin was identified as a particular concern.

Recent trends in Snake River spring/summer chinook salmon populations have been positive and the BRT noted that 20 out of 29 index populations had positive short term (5-year) gains through the 2001 broodyear (BRT 2003). This ESU saw a large increase in escapement in many (but not all) populations in 2001. The BRT considered this an encouraging sign, particularly given the record low returns seen in many of these populations in the mid 1990s. The 2002 and 2003 return years continued to be well above the longer term average and the 2004 return is currently predicted to also exceed the longer term (10-year) mean (Table 10.3). The recent abundance in this ESU is still less than the levels identified in the Proposed Recovery Plan for Snake River Salmon (NMFS 1995). The BRT considered it a positive sign that the non-native Rapid River broodstock has been phased out of the Grande Ronde Basin. However, the BRT identified the large hatchery production in this ESU as an ongoing risk that made it difficult to assess trends in natural productivity and growth rate.

Assessments by the BRT of the overall risks faced by this ESU were divided, with a majority concluding that this ESU fell in the “likely to become endangered” category, with minorities falling in the “danger of extinction” and “not likely to become endangered” categories. The BRT identified higher concerns associated with abundance and growth rate/productivity than with spatial structure and diversity.

Table 10.3. Wild Snake River Spring/summer chinook escapement estimates 1979-2003 (Escapement estimate from Joint Staff Report, total dam count from FPC). Estimates of hatchery fish are imprecise and were constructed from individual Hatchery and Genetic Management Plans.

Year	Snake River Wild Escapement	Lower Granite Dam total Count	Percent Wild/Natural	Hatchery in ESU	Percent In-ESU HOR	Total fish In-ESU	Percent In-ESU fish
1979	5,707	9,553	0.60	1520	0.16	7,227	0.76
1980	6,394	8,348	0.77	775	0.09	7,169	0.86
1981	11,486	16,441	0.70	1975	0.12	13,461	0.82
1982	11,153	16,577	0.67	1185	0.07	12,338	0.74
1983	9,970	13,412	0.74	1353	0.10	11,323	0.84
1984	7,765	11,940	0.65	1485	0.12	9,250	0.77
1985	10,773	30,145	0.36	3695	0.12	14,468	0.48
1986	10,739	37,876	0.28	5519	0.15	16,258	0.43
1987	10,198	34,726	0.29	5151	0.15	15,349	0.44
1988	11,217	35,740	0.31	9731	0.27	20,948	0.59
1989	5,579	16,124	0.35	5225	0.32	10,804	0.67
1990	8,203	22,408	0.37	2874	0.13	11,077	0.49
1991	5,429	10,432	0.52	1970	0.19	7,399	0.71
1992	11,612	24,405	0.48	2919	0.12	14,531	0.60
1993	10,781	28,924	0.37	8375	0.29	19,156	0.66
1994	1,697	3,915	0.43	1305	0.33	3,002	0.77
1995	1,107	1,797	0.62	542	0.30	1,649	0.92
1996	3,419	6,814	0.50	428	0.06	3,847	0.56
1997	11,767	44,564	0.26	6720	0.15	18,487	0.41
1998	6,957	14,209	0.49	2825	0.20	9,782	0.69
1999	2,927	6,556	0.45	3355	0.51	6,282	0.96
2000	3,334	37,761	0.09	12248	0.32	15,582	0.41
2001	17,186	185,693	0.09	25229	0.14	42,415	0.23
2002	34,125	97,184	0.35	22820	0.23	56,945	0.59
2003	38,881	86,751	0.45	22265	0.26	61,146	0.70

10.2 ASSESSMENT OF THE HATCHERY PROGRAMS

The list of populations and hatchery programs in this ESU indicates a balanced mix of natural-fish reserves and propagation programs, with about one half of the populations managed as wild fish reserves and hatchery programs divided between conservation programs and harvest. The states established wild salmon reserves well before this ESU was listed. Of the 16 populations managed as wild fish reserves, ten are located entirely within designated Wilderness including the Wenaha and Minam Rivers in Oregon, Chamberlain Creek, Big Creek, Lower Middle Fork, Camas Creek, Loon Creek, Pistol Creek, Sulphur Creek and Upper Middle Fork in Idaho. Six of the reserves have varying degrees of access including the Secesh River, Bear Valley Creek, Marsh Creek, North Fork Salmon, Main Salmon below Redfish Lake, and Valley Creek. All of the wild fish reserves are areas that were historically important spawning and rearing areas for spring/summer chinook salmon.

Development of chinook salmon hatchery programs are a relatively recent practice in the Snake River spring/summer chinook salmon ESU, compared to the lower Columbia Basin, Puget Sound, and coastal areas. Only one hatchery predates 1970, and most were initiated in the late 1970s through the 1990s as fish populations became depleted. All of the hatcheries were built to mitigate for losses caused by development of the FCRPS and private hydroelectric projects. In most cases these programs were not initiated until after the fish losses had already occurred. Generally hatcheries are located in subbasins that once were productive areas for natural fish and are integrated with the local, indigenous stocks that still persisted at the time the propagation program was initiated. The original purpose of the hatchery facilities was to compensate for lost fishing opportunity, but during the population declines through the 1980s and 1990s, propagation programs have operated to help conserve this ESU.

The following sections present a summary of artificial propagation programs in the Snake River spring/summer chinook ESU, and the relationship of the hatchery programs with natural populations. The Interior Columbia Basin TRT has identified 31 populations in the Snake River spring/summer chinook salmon ESU. Of the 31 populations, two may no longer exist as independent populations, 16 are being managed as wild/natural fish reserves, eleven have integrated hatchery programs associated with them, three have experimental captive rearing programs and one is affected by an isolated-harvest program. The broodstock and program history, similarity between hatchery origin and natural origin fish, program design, and program performance are described by population as outlined in Table 10.2**.**

10.2.1 Tucannon River Basin Artificial Propagation Programs

Hatchery facilities on the Tucannon River consist of a small hatchery, an adult trap and the Curl Lake acclimation pond. A 132,000 smolt conventional supplementation program operates using listed Tucannon River spring chinook salmon within this watershed. Adults are collected at the Tucannon Hatchery and transferred to Lyons Ferry Hatchery for spawning and juvenile rearing with smolts transferred to Curl Lake for acclimated and release. In recent rears a captive broodstock program sized to produce an additional 150,000 smolts was initiated when the natural population declined to critically low numbers in the mid 1990s. The captive program was designed to operate for only one generation and began phasing out with brood year (BY) 2002. Discussions are ongoing concerning increasing the size of the conventional production program once the captive broodstock program terminates in 2007. The Tucannon River program is operated by Washington Department of Fish and Wildlife (WDFW) as a satellite of the Lyons Ferry Hatchery, with funding by the Lower Snake River Compensation Program (LSRCP) for the conventional program and Northwest Power and Conservation Council (NWPCC) for the captive broodstock program.

10.2.1.1 Broodstock History. The conventional supplementation program on the Tucannon River began in 1985. The captive broodstock program began operation in 1997, and is being phased out beginning with BY 2002. Both the conventional and captive broodstock programs were derived from the local Tucannon River spring chinook salmon population. Natural fish have been continuously incorporated in the hatchery broodstock since the program began in 1985. An extensive monitoring and evaluation program is conducted to measure the performance of the hatchery and natural components of this population. (WDFW 2002a, WDFW 2004).

10.2.1.2 Similarity between Hatchery-origin and Natural-origin Fish. The hatchery broodstock was founded from the indigenous, natural-origin fish from the Tucannon River between 1985 and 1989. Since then, broodstock mating protocols have been managed for a 1:1 ratio of hatchery-origin to natural-origin fish in the hatchery broodstock. The captive broodstock were selected from a sample of the families created during the conventional egg-take so it is also composed of approximately 50% natural parents. All of the captive-broodstock progeny and the portion of the conventional progeny in excess of broodstock needs are allowed to spawn naturally during the current, rebuilding phase. As a result, the hatchery and natural components of this population are integrated and believed to be very similar.

10.2.1.3 Program Design. This program was initially designed as an integrated harvest program for LSRCP mitigation, but also incorporated an extensive monitoring and evaluation program to measure and compare the performance of the hatchery and natural components of this population. Declining adult returns led to the development of conservation goals and the short-term captive broodstock program in response to critical low population abundance in the 1990s. Current program design is to help rebuild the Tucannon River population and generate sufficient returns to initiate terminal harvest opportunities in the Tucannon River.

10.2.1.4 Program Performance. WDFW has an intensive monitoring program in place with weir counts, spawning grounds surveys, snorkeling, electrofishing and outmigrant traps to evaluate success of the hatchery program (WDFW 2002a, WDFW 2004). The monitoring program also incorporates genetic and ecological affects on the natural component of the Tucannon River spring/summer chinook population . Average natural escapement to the Tucannon River has been 323 spawners per year since 1985, with an estimated range of 3-718 fish (Table 10.4). Adult hatchery returns averaged 176 spawners per year since 1988 (when hatchery fish first began returning), with an estimated range of 20-335 fish (Table 10.4).

Table 10.4. Estimated total returns of natural and hatchery-origin spring chinook to the Tucannon River, 1985-2001.

Return Year	Natural Origin	Hatchery Origin	% Natural
1985	561	0	100.0
1986	686	0	100.0
1987	628	0	100.0
1988	438	20	95.6
1989	361	110	76.6
1990	494	260	65.5
1991	260	268	49.2
1992	418	335	55.5
1993	317	272	53.8
1994	98	42	70.0
1995	21	33	38.9
1996	163	84	66.0
1997	160	191	45.6
1998	85	59	59.0
1999	3	242	1.2
2000	82	257	24.2
2001	718	294	70.9

Parent-to-progeny ratios (R/S), and survival by various life stages have been calculated for natural and hatchery-origin Tucannon River spring chinook salmon as part of the LSRCP evaluation program (Table 10.5). Naturally reared spring chinook are currently below the replacement level with average Return/Spawner ratio of 0.9. Hatchery reared fish are currently above replacement with average R/S ratio of 2.5 (WDFW 2002a).

Table 10.5. Smolt-to-adult and parent-to-progeny (R/S) ratios for natural and hatchery reared Tucannon River spring chinook salmon (1985-1997 brood years). *Note: 1997 are incomplete returns through Age 4 only.*

	Natural Origin		Hatchery Origin	
Brood Year	**SAR**	**R/S**	**SAR**	**R/S**
1985	1.16	0.76	0.36	5.11
1986	0.80	0.82	0.21	3.59
1987	0.54	0.45	0.12	2.28
1988	1.41	1.58	0.31	5.14
1989	0.61	0.52	0.25	1.99
1990	0.19	0.15	0.03	0.36
1991	0.03	0.02	0.03	0.35
1992	0.38	0.34	0.09	0.98
1993	0.41	0.47	0.15	2.27
1994	0.20	0.17	0.03	0.49
1995	8.00	0.55	0.29	4.62
1996	4.28	0.50	0.34	3.51
1997		4.91		2.03

10.2.1.5 VSP Criteria

Abundance – Monitoring indicates that the hatchery program has increased returns and abundance of natural spawners. The conventional and captive propagation programs have increased total smolt outmigration of the combined natural and hatchery components.

Productivity – Smolt-to-adult return rates of natural smolts have consistently outperformed the hatchery smolts. However, the natural population is below replacement (0.9 returns/spawner), whereas the hatchery population is above replacement (2.5 returns/spawner). Monitoring indicates hatchery-origin adults are equally as productive as natural-origin adults when spawning naturally, but neither component exceeds 0.9 returns/spawner for natural reproduction (Michael Gallinat, WDFW personal Communication).

Diversity – Broodstock for the conventional program are collected from throughout the run and incorporate a 1:1 ratio of hatchery to natural fish. Broodstock for the captive program are selected as random samples of families made in the conventional mating. The hatchery program may have helped preserve diversity when the population declined to critically low abundance in the mid 1990s. Broodstock collection and mating protocols are designed to maximize effective breeding populations and protect diversity.

Distribution – Prior to the mid 1990s, this hatchery program may have displaced some of the naturally spawning fish to below the Tucannon Hatchery. This was believe to be caused by release location of the hatchery smolts (at the Tucannon Hatchery which is below much of the available habitat). This was corrected when the release location was moved to Curl Lake which is located above the Tucannon Hatchery. Naturally spawning fish appear to be well distributed throughout the habitat (WDFW 2004).

<u>Summary:</u> The Tucannon River spring chinook hatchery program is designed to be an integrated-harvest system, but has been operating in an integrated-recovery mode to rebuild the natural spawning population. Appropriate genetic and propagation management measures are in place to consider this hatchery program an overall benefit to the target population and the Snake River spring/summer chinook ESU. Some uncertainties regarding long-term productivity and sustainability are being addressed in the ongoing monitoring and evaluation actions.

10.2.2 Grande Ronde River Artificial Propagation Programs

There are four spring/summer chinook salmon programs located in the Grande Ronde Basin (Lostine River, Catherine Creek, Upper Grande Ronde, and Lookingglass Creek programs). All four programs are based at Lookingglass Hatchery, located on Lookingglass Creek, a tributary of the Grande Ronde River. Broodstock are collected and smolts are released at three satellite facilities located on the Upper Grande Ronde River, Catherine Creek, and Lostine River. Each of these programs are integrated with the local natural populations which are all identified as independent populations by the TRT. The fourth program located at Lookingglass Hatchery is a reintroduction program for Lookingglass Creek. The native population on Lookingglass Creek is extirpated, largely due to early use of imported hatchery stocks and a decision to exclude adults from the hatchery water supply.

Adults are collected at the tributary satellite facilities with spawning, incubation and rearing of juveniles occurring at Lookingglass Hatchery. Smolts are then transferred to tributary acclimation facilities for release. The Lostine River, Catherine Creek and Upper Grande Ronde programs are maintained as individual populations. The native population in Lookingglass Creek is no longer extant. Lookingglass Hatchery (LGFH) is located 18 miles north of the town of Elgin and operated by the Oregon Department of Fish and Wildlife (OFGW). The LGFH was constructed in 1982 as part of the LSRCP to rear 900,000 smolts to mitigate for spring chinook salmon losses caused by the four Federal dams constructed on the lower Snake River. The physical facilities are described in the HGMP for this program (ODFW 2002a). The LSRCP mitigation objective is to return 9,070 spring chinook adults above Lower Granite Dam.

Between 1982 and 1999 Lookingglass Hatchery imported Carson and Rapid River hatchery stocks for release throughout the Grande Ronde basin. Returning adults from these imported hatchery stocks strayed throughout the Grande Ronde basin in relatively high proportions to the natural populations. The 1991 status review identified this as a major risk to the ESU (Mathews and Waples 1991). These out-of-basin, non-ESU stocks are no longer released in the Grande Ronde Basin. Locally derived spring chinook salmon are now being propagation using both conventional and captive broodstock programs under ESA section 10 permits #1011 (ODFW) and 1149 (NPT).

10.2.3 Lostine River Spring Chinook Salmon Program

10.2.3.1 Broodstock History. The Lostine River program began in 1996 (BY 1995) with collection of parr for a captive broodstock program. A conventional program was initiated in

1997 by collecting natural-origin adults returning to the weir and trap on the lower Lostine River. Juvenile rearing occurs at Lookingglass Hatchery with smolts returned to the Lostine River for acclimation and release. The hatchery broodstock includes primarily natural-origin fish and few hatchery fish have been incorporated into the broodstock to date. In the future, the ratio of hatchery to wild fish collected for broodstock will be based on an adult escapement sliding scale (Table 9.6). This program is managed cooperatively with the Nez Perce Tribe (NPT) operating the facility on Lostine River, ODFW operating Lookingglass Hatchery, and the LSRCP and BPA providing the funding.

The captive broodstock program is maintained at specially designed facilities at Bonneville Hatchery (lower Columbia Basin) and NOAA Fisheries Manchester Lab located on Puget Sound, Washington. Captive brood stock for the Lostine is derived from chinook salmon parr collected in a stratified random manner along natural production areas in the Lostine River. Collection is based on proportion of total redds within each section. The goal is to provide a good probability of representing all families and to provide as much genetic variability in the collection as possible. No captive-propagation adults are used for conventional broodstock. Collection of naturally produced parr is expected to continue at least through 2004 with program review in 2005. It is anticipated that the captive-brood programs will transition to conventional smolt programs when adult escapement increases and adult collection becomes more reliable.

Table 10.6. Sliding Scale Management Plan for the Lostine River Spring Chinook Artificial Propagation Program.

Estimated total adult escapement to the Lostine River mouth (hatchery plus natural) [a]	Ratio of hatchery to natural adults at the mouth	Maximum % of natural adults to retain for broodstock	% of hatchery adults to retain for broodstock [b]	% of adults released above the weir can be of hatchery origin	Minimum % of broodstock of natural origin	% Strays allowed above the weir [c]
<250	Any	40	40	d	d	≤5
251-500	Any	20 [d]	20	≤70	≥20	≤5
>500	Any	≤20	[e]	≤50	≥30	≤5

[a] Pre-season estimate of total escapement
[b] Conventional hatchery adults only, all captive brood adults released to spawn naturally or outplanted
[c] For hatchery adults originating from different gene conservation groups (Rapid River stock or strays from outside the Grande Ronde basin)
[d] Not to exceed 130,000 smolt production initially
[e] Not decision factor at this level of escapement, percentage determined by other criteria

10.2.3.2 Similarity between Hatchery-origin and Natural-origin Fish. The Lostine River program was initiated in 1996 from locally derived fish and program fish are no more than one generation removed from natural parents. Broodstock objectives are to collect adults throughout the run and be representative of natural population. The hatchery and natural components of this program are believed to be very similar given the recent development of this program from natural fish.

10.2.3.3 Program Design. This program is designed to increase the number of adults on the spawning grounds leading to natural production. Additional objectives are to provide state and tribal harvest opportunities in the Grande Ronde basin (Zimmerman *et al.* 2002). Best management practices are applied to program implementation (ODFW 2002a). No captive-propagation adults are used in the conventional broodstock. Juvenile releases since program initiation are summarized in Table 10.7.

10.2.3.4 Program Performance. This is a relatively new program, started with BY 1995 parr and 1997 natural adult returns. The first small release of smolts occurred in 1999, and only one year of adult returns have been recorded. ODFW and NPT have set up extensive monitoring of performance with adult traps, outmigrant traps, spawning ground surveys and genetic analysis to evaluate the success of this propagation program and its affect on the indigenous natural populations. Current program performance has not been determined due to the formative status of the program. There is no data completed regarding smolt-to-adult survival rate, total adult production number, and escapement numbers to target areas at this time (ODFW 2002a). Annual production numbers and returns are summarized in annual operating plans assembled by the state and two Tribes that co-manage these programs (ODFW 2004, Table 10.7).

Table 10.7. Annual smolt releases into the Lostine River from captive and conventional supplementation programs (From project AOPs).

Brood year/ Release Year	Captive Broodstock Program	Conventional Broodstock Program	Total Captive and Conventional
1997/1999	-0-	11,900	11,900
1998/2000	35,130	-0-	35,130
1999/2001	135,100	-0-	135,100
2000/2002	78,000	31,000	109,000
2001/2003	142,000	101,000	243,000
2002/2004	133,900	116,000	249,900
2003/2005[1]	95,400	92,000	187,400

[1] BY 2003 releases for 2005 are projected

10.2.3.5 VSP Criteria

<u>Abundance</u> **–** The Lostine River propagation program has successfully increased the number of individual fish in this population short-term, with total captive and conventional smolt releases approaching 250,000 in recent years and increasing number of adults released for natural spawning escapement.

<u>Productivity</u> **–** With only one completed brood year of limited adult returns from the captive and conventional smolt programs, it is too early in the program to evaluate either short- or long-term

affects on population productivity or success of the hatchery component.

Diversity **–** This propagation program is designed and managed to select broodstock representative of the source population, increase the effective breeding population size, and avoid selection. Increasing the abundance of the native stock is expected to reduce demographic effects related to the very small natural population size. Phasing out the out-of-basin Carson and Rapid River stocks (at Lookingglass Hatchery) is believed to have reduced a significant risk factor to this population.

Distribution **–** This program is designed to supplement the local, Lostine River chinook population and is sized appropriately for the capacity of the basin. Naturally spawning fish are widely distributed in the Lostine River. As numbers of returning adults increase, spawning and rearing salmon are expected to utilize all of the available, suitable habitat in the basin. However, the effects on distribution from this program is still an unknown.

10.2.4 Catherine Creek Spring Chinook Salmon Program

10.2.4.1 Broodstock History. The Catherine Creek program began in 1996 (BY 1995) with collection of parr for a captive broodstock program. A conventional program was initiated in 2001 by collecting natural-origin adults returning to the weir and trap on Catherine Creek. Juvenile rearing occurs at Lookingglass Hatchery with smolts returned to the Catherine Creek for acclimation and release. The conventional broodstock includes primarily natural-origin fish and few hatchery fish have been incorporated into the broodstock to date. In the future, the ratio of hatchery to wild fish collected for broodstock will be based on an adult escapement sliding scale (See above in Lostine River discussion). The program is sized to produce approximately 250,000 spring chinook salmon smolts. This program is managed cooperatively with the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) operating the facility on Catherine Creek, ODFW operating Lookingglass Hatchery, and the LSRCP and BPA providing the funding.

The captive broodstock program is maintained at specially designed facilities at Bonneville Hatchery (lower Columbia Basin) and NOAA Fisheries Manchester Lab located on Puget Sound, Washington. Captive brood stock for the Catherine Creek portion of this program are derived from chinook salmon parr collected in a stratified random manner along natural production areas in Catherine Creek. Collection is based on proportion of total redds within each section. The goal is to provide a good probability of representing all families and to maintain as much genetic variability in the collection as possible. No captive-propagation adults are used for conventional broodstock. The captive broodstock program is scheduled to be reviewed in 2004 and may be phased out starting with BY 2005.

10.2.4.2 Similarity between Hatchery-origin and Natural-origin Fish. The Catherine Creek program was initiated in 1996 from locally derived fish and are no more than one generation removed from natural parents. Broodstock objectives are to collect adults throughout the run and be representative of the natural population. The hatchery and natural components of this program are believed to be very similar given the recent development of this program from natural fish.

10.2.4.3 Program Design. This program is designed to increase the number of adults on the spawning grounds leading to natural production. Additional objectives are to provide state and tribal harvest opportunities in the Grande Ronde basin (Zimmerman *et al.* 2002). Best management practices are applied to program implementation (ODFW 2002a). All hatchery fish are marked with adipose clips and juvenile releases are summarized in Table 10.8. No captive-propagated adults are used in the conventional program. Current plans also call for using Catherine Creek stock to reintroduce native Grande Ronde basin spring chinook salmon to Lookingglass Creek.

10.2.4.4 Program Performance. This is a relatively new program, started with BY 1995 parr and 2001 natural adult returns. The first release of smolts occurred in 2000, and only one year of adult returns have been recorded. ODFW and CTUIR have set up extensive monitoring of performance with adult traps, outmigrant traps, spawning ground surveys and genetic analysis to evaluate the success of this propagation program and its affect on the indigenous natural populations. Current program performance has not been determined due to the formative status of the program. There is no data completed regarding smolt-to-adult survival rate, total adult production number, and escapement numbers to target areas at this time (ODFW 2002a). Annual production numbers and returns are summarized in annual operating plans assembled by the state and two Tribes that co-manage these programs (ODFW 2004).

Table 10.8. Annual smolt releases into Catherine Creek from captive and conventional supplementation programs (From project AOPs).

Brood year/ Release Year	Captive Broodstock Program	Conventional Broodstock Program	Total Captive and Conventional
1998/2000	38,100	-0-	38,100
1999/2001	139,100	-0-	139,000
2000/2002	181,000	-0-	181,000
2001/2003	105,000	24,400	129,400
2002/2004	92,600	71,000	163,600
2003/2005[1]	58,800	88,000	146,800

[1] BY 2003 releases for 2005 are projected

10.2.4.5 VSP Criteria

Abundance **–** The Catherine Creek propagation program has successfully increased the number of individual fish in this population short-term, with combined captive and conventional smolt releases averaging 150,000 in recent years and increasing number of adults released for natural spawning escapement.

Productivity **–** With only one completed brood year of limited adult returns from the captive and conventional smolt programs, it is too early in the program to evaluate either short- or long-term affects on population productivity or success of the hatchery component.

Diversity – This program may have helped preserve remaining diversity in this population in the mid 1990s when the population was at very low abundance. The propagation program is designed and managed to select broodstock representative of the source population, increase the effective breeding population size, and avoid selection. Increasing the abundance of the native stock is expected to reduce demographic effects related to the very small natural population size. Phasing out the out-of-basin Carson and Rapid River stocks is believed to have reduced a significant risk to the native fish.

Distribution – This program is designed to supplement the local, Catherine Creek chinook population and is sized appropriately for the capacity of the basin. Naturally spawning fish are widely distributed in Catherine Creek. As numbers of returning adults increase, spawning and rearing salmon are expected to utilize all of the available, suitable habitat in the basin. However, the effects on spawning distribution from this program is still an unknown.

10.2.5 Upper Grande Ronde River Spring Chinook Salmon Program

10.2.5.1 Broodstock History. The upper Grande Ronde program began in 1996 (BY 1995) with collection of parr for a captive broodstock program. A conventional program was initiated in 2001 by collecting natural-origin adults returning to the weir and trap on the upper Grande Ronde River. Juvenile rearing occurs at Lookingglass Hatchery with smolts returned to the Grande Ronde River for acclimation and release. The broodstock includes primarily natural-origin fish and few hatchery fish have been incorporated into the broodstock to date. Unlike the Lostine and Catherine Creek programs, the adult sliding scale outlined in NMFS permits #1011, Modification 2 and #1049 will not be used for management in the upper Grande Ronde River. There is no restriction on the proportion of hatchery adults (conventional + captive) escaping above the weir.

Broodstock collection guidelines are as follows:

$ Up to 50% of the wild fish returning to the weir can be collected.
$ Conventional program hatchery fish will be collected at a rate necessary to meet the remainder of the broodstock goal (could be up to 100% of returning conventional adults).
$ No captive progeny adults (F-1) will be used for brood.
$ A juvenile sliding scale will not be used to determine smolt production limits.
$ Implement an overall production goal (captive + conventional) of 250,000 smolts without any specific cap for each type of production but with a priority for conventional.
$ A target of 130,000 conventional smolts will be produced in the near term (while the captive evaluation is ongoing), increasing to 250,000 in the long term.
$ During the initial phase of the restoration program, the goal is to release 120,000 captive brood smolts and 130,000 conventional brood smolts to meet the research study design. However, if production of either the proposed captive or conventional smolt groups is limited or unavailable, additional smolts could be released, if available, from the other

broodstock group, up to the overall production goal of 250,000.

- Additional production above the captive smolt goal will be outplanted as eggs or presmolts into Sheep Creek, Meadow Creek, and/or upper Grande Ronde River below the primary production area.
- No outplanting of progeny of another program stock will occur into this tributary.

This program is managed cooperatively with the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) operating the facility on the Grande Ronde River, ODFW operating Lookingglass Hatchery, and the LSRCP and BPA providing the funding.

The captive broodstock program is maintained at specially designed facilities at Bonneville Hatchery (lower Columbia Basin) and NOAA Fisheries Manchester Lab located on Puget Sound, Washington. Captive brood stock for the upper Grande Ronde program were derived from chinook salmon parr collected in a stratified random manner along natural production areas in the Lostine River. Collection is based on proportion of total redds within each section. The goal is to provide a good probability of representing all families and to maintain as much genetic variability in the collection as possible. No captive-propagation adults are used for conventional broodstock.

10.2.5.2 Similarity between Hatchery-origin and Natural-origin Fish. The upper Grande Ronde program was initiated in 1996 from locally derived fish and program fish are no more than one generation removed from natural parents. Broodstock objectives are to collect adults throughout the run and be representative of the natural population. The hatchery and natural components of this program are believed to be very similar given the recent development of this program from natural fish.

10.2.5.3 Program Design. This program is designed to increase the number of adults on the spawning grounds leading to natural production. Additional objectives are to provide state and tribal harvest opportunities in the Grande Ronde basin (Zimmerman et al 2002). Best management practices are applied to program implementation (CTUIR 2002). The program releases are summarized in Table 10.9 and have ranged from 1,500 to 237,000 with the goal being 250,000 smolts (CTUIR 2002). All hatchery fish are marked with cwt only. No captive-propagated adults are used in the conventional program.

10.2.5.4 Program Performance. This is a relatively new program, started with BY 1995 parr and 2001 natural adult returns. The first, very small, releases of smolts occurred in 2000 and 2001, and few adult returns have been recorded. ODFW and CTUIR have set up extensive monitoring of performance with adult traps, outmigrant traps, spawning ground surveys and genetic analysis to evaluate the success of this propagation program and its affect on the indigenous natural populations. The program has not been in operation long enough to clearly assess performance. Annual production numbers and returns are summarized in annual operating plans assembled by the state and two Tribes that co-manage these programs (ODFW 2004, Table 10.9).

Table 10.9. Annual smolt releases into the Upper Grande Ronde River from captive and conventional supplementation programs (From project AOPs).

Brood year/ Release Year	Captive Broodstock Program	Conventional Broodstock Program	Total Captive and Conventional
1998/2000	1,570	-0-	1,570
1999/2001	2,600	-0-	2,600
2000/2002	150,000	-0-	150,000
2001/2003	210,000	27,000	237,000
2002/2004	78,900	70,000	148,900
2003/2005[1]	1,000	105,000	106,000

[1] BY 2003 releases for 2005 are projected

10.2.5.5 VSP Criteria

Abundance **–** The upper Grande Ronde River propagation program has been less successful than the Lostine and Catherine Creek programs in terms of increasing the number of individual fish in the population, but smolt releases have increased. The first returns of 4-year-old adults resulting from a sizable smolt release is expected in 2004. However, the program is believed to have improved the abundance of this stock compared to what might have persisted without artificial propagation.

Productivity **–** With only two years of limited adult returns from the captive smolt program, it is too early in the program to evaluate either short- or long-term affects on population productivity or success of the hatchery component at natural reproduction.

Diversity **–** This program may have helped preserve remaining diversity in this population when the population was at very low abundance. This propagation program is carefully designed and managed to select broodstock representative of the source population, increase the effective breeding population size, and avoid selection. Increasing the abundance of the native stock is expected to reduce demographic effects related to the very small natural population size. Phasing out the out-of-basin Carson and Rapid River stocks is believed to have reduced a significant risk to the native fish.

Distribution **–** This program is designed to supplement the local, upper Grande Ronde River chinook salmon population and is sized appropriately for the capacity of the basin. As numbers of returning adults increase, spawning and rearing salmon are expected to utilize all of the available, suitable habitat in the basin. However, the effects on spawning distribution from this program is still an unknown.

10.2.6 Lookingglass Creek Spring Chinook Salmon Program

10.2.6.1 Broodstock History. Lookingglass Hatchery began operating in 1982. Between 1982 and 1999 Carson and Rapid River hatchery stocks were imported for release in the Grande Ronde River. Although most releases occurred at Lookingglass Hatchery, presmolts, smolts or adults were outplanted in Catherine Creek, the upper Grande Ronde River, and the Wallowa River periodically from 1980 to 1990 (LSRCP 1998). Returning adults from these imported hatchery stocks strayed throughout the Grande Ronde basin in relatively high proportions to the natural populations. The 1991 status review identified this as a major risk to the ESU (Mathews and Waples 1991). These out-of-basin, non-ESU stocks are no longer released in the Grande Ronde Basin. The indigenous stock of Lookingglass Creek was extirpated by a combination of out-of-basin hatchery releases and a decision to eliminate spawning salmon from the hatchery water supply in the 1980s. A reintroduction effort was initiated with the release of BY 2000 Catherine Creek captive broodstock parr that were excess to conservation needs and Catherine Creek program goals (Table 10.10).

Table 10.10. Releases of parr and smolts into Lookingglass Creek for restoration of natural spawning populations. Stock designations are RR (Rapid River) and CC (Catherine Creek).

Stock	Broodyear	Rel. Year	Lifestage	Number Released	Release Location	Fin-clip/Tag
RR	1998	1999	Parr	57,290	Upp. LGC	Ad
RR	1999	2000	Parr	24,201	Upp. LGC	Ad
CC	2000	2001	Parr	51,864	Hatchery	Ad
CC	2001	2002	Parr	32,803	Hatchery	Ad
CC	2002	2004	Smolt	53,330	Hatchery	Ad CWT
CC	2003[1]	2005	Smolt	100,000	Hatchery	Ad CWT

[1] BY 2003 release numbers projected

10.2.6.2 Similarity between Hatchery-origin and Natural-origin Fish. The indigenous Lookingglass stock was extirpated by the early 1990's. Catherine Creek has been selected as the geographically most proximate Grande Ronde Basin tributary stock which has a life history similar to the extirpated stock and sufficient abundance to support the reintroduction effort. The captive-broodstock smolts released into Lookingglass Creek are no more than one generation removed from natural parents.

10.2.6.3 Program Design. This program is designed to reestablish a run of natural and artificially propagated spring chinook salmon derived from chinook native to the Grande Ronde Basin back into Lookingglass Creek. The program is also designed to provide tribal and state harvest opportunities once adults return in sufficient numbers (Zimmerman et al 2002). Annual releases of up to 150,000 smolts from Catherine Creek captive or anadromous returns is planned with the program transitioning to a conventional smolt program once adults begin returning to Lookingglass Creek. The eventual goal is to reintroduce native salmon back into Lookingglass Creek and develop a localized hatchery stock.

10.2.6.4 Program Performance. This is a new program and it is to early to determine program performance. The first releases of small numbers of parr in 2001 and 2002 and smolts in 2003 and 2004 have not yet produced adult returns. ODFW and CTUIR have set up extensive monitoring of performance with adult traps, outmigrant traps, spawning ground surveys and genetic analysis to evaluate the success of this propagation program and its affect on the indigenous natural populations.

10.2.6.5 VSP Criteria

Abundance **–** The Lookingglass Creek propagation program began releases with BY 2000 parr released in 2001and BY 2002 smolts released in 2004. It is too early in the program to determine if adults will be successfully produced from this initial release.

Productivity **–** It is too early in the program to evaluate either short- or long-term affects on population productivity or success of the hatchery component at natural reproduction.

Diversity **–** This propagation program is designed to develop a localized broodstock representative of a population believed to be similar and geographically proximate to the extirpated native stock. Development of a localized broodstock based on the listed, in-ESU stock while phasing out the out-of-basin Carson and Rapid River stocks is believed to have reduced a significant risk to native fish within the Grande Ronde basin. A successful reintroduction should increase the diversity of spring chinook salmon in the Grande Ronde Basin as fish adapt to Lookingglass Creek over time.

Distribution **–** Restoring a natural spawning population to Lookingglass Creek will increase the distribution of listed salmon within the ESU.

10.2.7 Imnaha River and Big Sheep Chinook Propagation Programs

10.2.7.1 Broodstock History. The Imnaha River spring/summer chinook salmon program was initiated in 1982 under the LSRCP as an integrated-harvest program designed to mitigate for fishery and habitat losses related to the four federal dams on the lower Snake River. It is operated by ODFW. From its inception, the program has had a strong monitoring and evaluation element designed to measure and compare performance between the hatchery and natural components of the population. The initial program goal also included supplementation of the Imnaha River natural spawning component. The program operated as a gene reserve when the Snake River spring/summer chinook runs declined in the mid 1990s. Native Imnaha River spring/summer chinook salmon stock are trapped at the Imnaha Satellite Facility located near Gumboot Creek on the upper Imnaha River. This facility is operated as a satellite of Lookingglass Hatchery by ODFW under section 10 permit #1128. Adults are spawned at the satellite facility, eggs transferred to Lookingglass Hatchery for rearing, and smolts are transferred back for final acclimated and released at the satellite facility.

The Big Sheep program began in the mid 1990s and includes up to 150 pair of Imnaha River spring chinook salmon adults outplanted to Lick Creek and Big Sheep Creeks. The program also includes 70,000 smolts released in the Big Sheep Creek drainage when the total Imnaha program reaches designed production of 490,000, but hatchery space constraints have not allowed that production level to date (ODFW 2002b).

10.2.7.2 Similarity between Hatchery-origin and Natural-origin Fish. The program operational practices follow the concepts and strategies of supplementation as defined and outlined in RASP (1992) and Cuenco *et al.* (1993). This hatchery stock was founded in 1982 (22 years or 4.5 chinook salmon generations in operation) from the local population and has included an average of over 30% natural-origin adult salmon in annual egg takes. Hatchery-origin salmon are released for natural spawning escapement based on a sliding scale of adult returns to the basin as specified in section 10 direct take permit 1128 (NMFS 2000) (Table 10.11). The propagation program attempts to avoid selection and maintain the genetic and behavioral characteristics of the source population.

Table 10.11. Sliding scale allocation for spring/summer chinook salmon returning to the Imnaha River at the Gumboot Weir (ODFW 1998).

Estimated total adult escapement to the Imnaha River mouth	Ratio of hatchery to natural adults at the mouth	Maximum % natural adults to retain for broodstock	Maximum % hatchery adults to retain for broodstock	Maximum % adults of hatchery released above the weir	Minimum % of broodstock of natural origin
<51	Any	0	0	a	NA
51-700	Any	50	50	a	a
701-1000	Any	40	a	70	20
1001-1400	Any	40	a	60	25
>1400	Any	30	a	50	30

NA – Not applicable.
a – Percentages determined as a result of implementing other criteria, therefore not a decision factor.

10.2.7.3 Program Design. This program is designed to increase the number of adults on the spawning grounds leading to natural production as well as provide tribal and state fishing opportunities in years of abundant returns (ODFW 2002b). The goal of this program is the restoration of spring/summer chinook salmon in the Imnaha River using the indigenous stock and to mitigate for fish losses occurring as a result of the construction and operation of the four Lower Snake River Dams. The program mitigation goal is to return 3,210 hatchery adults to the area above Ice Harbor Dam. Based upon this adult goal and an estimated 0.65% smolt-to-adult survival rate the target for smolt production was set at 490,000 fish.

Program specific goals are summarized in Table 10.12 and include:

$ Establishing an annual supply of brood fish that can provide an egg source capable of meeting mitigation goals.
$ Restore and maintain the natural spawning population.

- $ Reestablish sport and tribal fisheries.
- $ Establish a total return of adult fish resulting from LSRCP activities in Oregon that meets the mitigation goal.
- $ Minimize the impacts of the program on resident stocks of game fish.

Table 10.12. Proposed annual fish release levels (maximum number) by life stage and location from the Imnaha spring/summer chinook production program (ODFW 2002b).

Life Stage	Release Location	Annual Release Level
Yearling	Imnaha River (Acclimated)	420,000
Yearling	Lick Creek (Direct Stream)	35,000
Yearling	Big Sheep Creek (Direct Stream)	35,000
Adult	Lick Creek (Direct Stream)	150 (75 pairs)
Adult	Big Sheep Creek (Direct Stream)	150 (75 pairs)

Since the beginning of this program in 1982 only natural or hatchery produced Imnaha River spring/summer chinook salmon have been used for brood stock. Table 10.13 indicates the proportion of unmarked fish used for the hatchery broodstock.

Table 10.13. Imnaha River spring/summer chinook salmon spawning data for the 1990 through 2001 brood years. (ODFW 2002c)

Brood Year	Marked Males Spawned	Marked Females Spawned	Unmarked Males Spawned	Unmarked Females Spawned	% Un-marked	Spawning Ratio F/M	Average Fecundity	Egg Take (1,000's)	Fry Ponded (1,000s)
1990	35	49	39	25	43.2%	1.00	4,414	327	270
1991	11	24	27	15	54.5%	1.03	4,954	193	163
1992	46	86	69	28	42.4%	0.99	4,754	542	465
1993	134	139	58	54	29.1%	1.01	5,425	1,047	1,010
1994	15	13	6	9	34.9%	1.05	5,082	112	96
1995	16	9	30	6	59.0%	0.33	4,541	68	51
1996	15	7	37	17	71.1%	0.46	4,276	103	102
1997	54	50	8	7	12.6%	0.92	4,962	283	206
1998	53	33	31	28	40.7%	0.59	5,059	309	183
1999	183	31	14	6	8.5%	*0.16			
2000	240	58	46	10	15.8%	*0.19	5,048	334	311
2001	114	56	54	49	37.8%	*0.38	4,371	459	275

*Three-year olds males (jacks) are included in the marked males spawned. Milt is pooled and used to fertilize a maximum of 10% of the available eggs; therefore, the % marked fish and spawning ratio (F/M) are skewed.

10.2.7.4 Program Performance. The propagation program fell far short of production and return goals during most of the 1980s and 1990s. Table 10.14 indicates that parent replacement ratios were less than 1.0 for natural-origin fish in nearly every year between 1982 and 1995, while the ratios exceeded 1.0 for the hatchery-origin component of the population (ODFW 2002b).

Table 10.14. Comparison of progeny to parent ratios for the Imnaha hatchery program and the natural spawning population in the Imnaha River 1982-1995 (age-three males included).

Year	Hatchery	Natural
1982	8.82	1.05
1983	1.25	1.15
1984	3.08	0.26
1985	1.96	0.17
1986	1.52	0.41
1987	3.73	0.44
1988	12.60	0.72
1989	3.81	0.55
1990	0.51	0.20
1991	1.09	0.20
1992	0.62	0.50
1993	2.56	0.25
1994	0.82	0.61
1995	11.44	2.52

Spawner :recruit ratios have not been calculated for the most recent years, However, since the 1996 year class which emigrated in 1998 and returned as adults in 2000 and 2001, adult returns have increased indicating improved spawner-to-recruit ratios (Table 10.15).

Table 10.15. Total Escapement, Number of Broodstock Collected, and Number and Origin of Natural Spawners in the Imnaha River (1979–2003). (NPT 2004)

Year	Total Escapement	Broodstock Collected		Natural Spawners		Natural Spawners of Hatchery Origin (%)
		Natural	Hatchery	Natural	Hatchery	
1979*	192	0	0	192	0	0
1980*	125	0	0	125	0	0
1981*	307	0	0	307	0	0
1982	1,262	28	0	1,234	0	0
1983	990	64	0	926	0	0
1984	1,178	36	0	1,142	0	0
1985	1,844	115	14	1,573	142	8
1986	1,165	315	21	788	51	6
1987	644	83	22	484	55	10
1988	928	140	68	609	111	15
1989	697	105	187	297	108	27
1990	627	81	159	199	188	49
1991	959	51	262	198	448	70
1992	1,353	54	331	205	763	79
1993	1,724	58	394	430	842	66
1994	311	20	31	118	142	55
1995	432	38	30	204	160	44
1996	535	72	61	266	136	34
1997	517	23	149	129	216	63
1998	586	77	57	255	197	44
1999	1,676	22	254	287	1,113	80
2000	2,364	49	282	647	1,364	68
2001	6,356	86	169	2,465	3,134	56
2002	5,269	38	276	1,042	3,311	76
2003	5,387	75	304	1,623	3,020	65

Notes: Jacks are included in the estimates. Total escapement is the sum of total natural spawners estimated from redd counts and fish retained for hatchery broodstock.
*Estimates prior to 1982 are based on redd counts above the location of the weir and not expanded for those fish spawning below the weir location.
Data sources: from ODFW files, LaGrande office.

10.2.7.5 VSP Criteria

Abundance – The propagation program has apparently contributed to increasing the total number of fish in the combined natural and hatchery origin population. Adult returns have increased to average 4,400 fish in the past 5 run years compared to 775 in the preceding decade. Natural spawning escapements of combined hatchery and natural-origin fish have increased to numbers similar to the peak abundance recorded in the 1950s and 1960s .

Productivity – Productivity in recent years has markedly increased from that seen in the 1980s and 1990s. Some of the large natural-origin returns in the past few years were produced by spawning escapements that were 70% or more hatchery-origin fish. However, much of this improved survival is thought to be based on generally improved ocean conditions and longer-term affects on natural fish productivity remains uncertain.

Diversity **–** The program attempts to maintain genetic diversity representative of the source population. In some years, the weir can not be installed in the river until after flows drop and the early component of the run can not be collected. It is unclear what effect this may have over time, but currently no signs of divergence have been reported. The out-planting of adults from the Imnaha program into the Big Sheep Creek basin may have reduced the diversity within the Imnaha basin, however, natural fish were are very low abundance levels when this outplanting was initiated in the mid 1990s. The historic Big Sheep and Lick Creek spawning aggregates may no longer survive as an independent population.

Distribution – Spring/summer chinook salmon are using available habitat throughout the mainstem Imnaha River. However, there is some indication that a slightly larger percentage of fish spawn below the weir that did historically. Outplanting of adults to Big Sheep and Lick Creeks has likely expanded habitat used by spring chinook salmon.

10.2.8 Little Salmon River – Rapid River Hatchery

10.2.8.1 Broodstock History. Rapid River Hatchery was constructed in 1964 to mitigate for fishery losses caused by Idaho Power Companies (IPC) Hells Canyon Hydroelectric Complex on the Snake River. The hatchery is located on Rapid River, a tributary to the Little Salmon River near Riggins, Idaho, approximately 606 river miles from the mouth of the Columbia River. The program is operated as an isolated harvest program by the Idaho Department of Fish and Game (IDFG) with funding from IPC. The Rapid River spring chinook stock was developed from adults trapped at Oxbow and Hells Canyon Dams on the Snake River. When efforts to maintain spring chinook salmon runs upstream from the Hells Canyon Hydroelectric complex failed, the run was transferred to Rapid River. The hatchery stock is believed to be a composite of several stocks that existed in Snake River tributaries above Hells Canyon Dam. These fish were transferred from their native waters to an adjacent basin and have been maintained exclusively by artificial propagation since 1964. The hatchery stock represents the remaining genetic resource for spring/summer chinook salmon populations that once returned to the Snake Basin above Hells Canyon Dam This hatchery stock is not considered to be part of the listed Snake River spring/summer chinook ESU.

10.2.8.2 Similarity between Hatchery-origin and Natural-origin Fish. Rapid River hatchery is operated as an isolated harvest program and is not intended to represent a population within this ESU. However, the natural-origin chinook salmon spawning in Rapid River and the Little Salmon River are genetically indistinguishable from the hatchery stock (Dr. Paul Moran, NWFSC personal communication). This is thought to be the result of hatchery operations prior to the early 1990s when natural-origin fish were separated from hatchery-origin fish and released above the hatchery weir based on visual characteristics and a belief that the natural-origin stock was a later timed, “summer” run. In subsequent years, when all hatchery-origin fish have been marked and it was noted that natural-origin fish sometimes arrived earlier and dark, and some hatchery-origin fish were later timed and bright**.** Current genetic surveys indicate that the hatchery-origin and natural-origin fish in the Little Salmon River and Rapid River are of similar origin.

10.2.8.3 Program Design. Rapid River is an isolated harvest program designed for mitigation. Only marked hatchery fish are used for broodstock in this program. Unmarked spring/summer chinook salmon are released above the hatchery to spawn. The production goal is 3 million spring chinook smolts, with 2.5 million released directly from the rearing ponds into Rapid River and 0.5 million released into the Snake River below Hells Canyon Dam on the Snake River. Broodstock is collected across the entire run timing and representative of the age and sex structure of the total return. Surplus eggs are provided to Clearwater Basin spring chinook salmon hatchery programs when shortfalls occur in those program. Surplus adults are also outplanted to the Clearwater Basin in a cooperative program between IDFG, NPT, and USFWS.

10.2.8.4 Program Performance. Rapid River has been notably successful as a mitigation program and has provided Tribal and recreational harvest opportunity during most of the past three decades when other hatcheries and natural populations have been very depressed. The program has also been the source for reintroduction of chinook salmon into the Clearwater River basin where native stocks were extirpated.

10.2.8.5 VSP Criteria

<u>Abundance</u> **-** This hatchery stock is not contributing to abundance of this ESU.

<u>Productivity</u> - N/A

<u>Diversity</u> - The hatchery program appears to be isolated from natural populations and is not believed to be affecting existing diversity within the ESU. The native Rapid River spring/summer chinook salmon appear to have been replace by the imported hatchery stock. A natural population, genetically similar to the hatchery stock is present in Rapid River.

<u>Distribution</u> - The hatchery program is believed to have no affect on current distribution within the ESU.

10.2.9 South Fork Salmon River Summer Chinook Salmon Program

10.2.9.1 Broodstock History– McCall Hatchery. McCall Hatchery was constructed in 1979 by the USACE as part of the LSRCP and is operated by IDFG. The hatchery is located within the city limits of McCall, Idaho on the North Fork Payette River, approximately 0.25 miles downstream from Payette Lake. The hatchery is used for incubation and rearing of summer chinook salmon from the South Fork Salmon River. Adult collection and spawning is conducted at the South Fork Salmon River Satellite facility, located near Warm Lake and approximately 50 miles southeast of the hatchery. The LSRCP mitigation goal is to return 8,000 adult summer chinook salmon above Lower Granite Dam to compensate for anadromous fishery losses due to the construction of the four lower Snake River dams. Hatchery fish from the South Fork program are included in the Snake River spring/summer chinook ESU.

The broodstock was founded from adult summer chinook salmon collected between 1978 and 1979 at Little Goose Dam, on the lower Snake River. In 1980, 50 percent of the broodstock collection was shifted to the upper South Fork Salmon River and the other 50 percent was collected at Lower Granite Dam. Adults were collected during the summer run period at the dams and the South Fork Salmon River is thought to have contributed the largest component. However, this early stock probably included some portion of later returning summer chinook salmon destined to other Snake River tributaries. Early collections established an egg bank program prior to the completion of McCall Hatchery. Beginning in 1980, smolts produced from these early collections were planted in the South Fork Salmon River upstream of the present location of the weir. Since 1981, broodstock have been collected entirely from the upper South Fork Salmon River weir (LSRCP 1998).

10.2.9.2 Similarity between Hatchery-origin and Natural-origin Fish. The original broodstock collected at the lower Snake River dams may have been a composite of later run timed spring/summer chinook salmon, but the 1978 and 1979 egg takes were relatively small (LSRCP 1998). Beginning in the 1980's through 1992 (when the ESU was first listed) natural fish were incorporated into the broodstock and the hatchery and natural components of the upper South Fork population were believed to be fully integrated. At this time hatchery fish were also allowed to spawn naturally based on a sliding scale and overall abundance (IDFG 1994). Subsequent to the 1992 listing, IDFG has managed the program to maintain two groups of hatchery fish. The first group (supplementation component), has remained fully integrated with the natural population by incorporating natural fish into the broodstock. The second group (reserve component), is composed of known hatchery fish whose linage predates the listing and has not incorporated natural fish (IDFG 2002a). This later group of hatchery fish has used only marked hatchery fish for broodstock for 12 years and some divergence may be occurring.

This program only represents the fish that return to the upper South Fork above the satellite facility and is isolated from the Secesh and East Fork South Fork populations identified by the TRT. The hatchery program is also operated in isolation from the natural spawning aggregate at Poverty Flats(identified by the TRT as part of the mainstem South Fork population), some 20 miles downstream from the broodstock collection facilities. Thus, the hatchery program is integrated with only a portion of the mainstem South Fork population.

10.2.9.3 Program Design. The South Fork program was initially designed as an integrated-harvest program with a secondary goal of supplementation of natural spawning. The original plan called for taking approximately 35% of the broodstock as natural fish and allowing up to 35% of the natural spawners to be hatchery-origin fish (IDFG 1994). Beginning in 1992, the program has been managed to achieve two objectives; to supplement the upper South Fork natural population with the supplementation group described above and to provide state and tribal fishing opportunities by producing smolts from known hatchery-by-hatchery crosses (the “reserve” group described above). Some of the reserve group of hatchery fish were allowed to spawn naturally in the mid 1990s when the South Fork population was reduced to a critically low abundance. The IDFG is phasing out the supplementation element of this program as part of the “Idaho Supplementation Studies” (ISS) experiment (IDFG 1991). Beginning with BY 2004, the IDFG will be managing the entire program as an isolated harvest program.

The program rears and releases approximately 1.0 million summer chinook salmon smolts into the upper South Fork Salmon River. The hatchery has supported state recreational and tribal fisheries in the South Fork in recent years. Surplus hatchery adults are also outplanted to vacant habitat in the East Fork South Fork Salmon River. Eggs are also provided to the Shoshone-Bannock Tribes (SBT) for their egg incubation project to return spring/summer chinook salmon so previously vacant tributary habitat in the upper South Fork. McCall Hatchery is also used to rear listed Snake River spring/summer chinook salmon for the NPT Johnson Creek Artificial Production Enhancement (JCAPE) supplementation experiment.

10.2.9.4 Program Performance. Over the first 20 years of program operation smolt-to-adult returns (SARs) averaged 0.34% and annual adult returns ranged from a few thousand fish to as low as 80 fish and SAR of 0.01% in 1990 (IDFG McCall Hatchery files). Since the BY1996 release in 1998, SARs have been between 0.8 and 1.1% and the total return has been 8,000 to 12,000 hatchery-origin adults. The majority of these hatchery adults originate from the reserve group of fish. At those levels the program supports tribal and recreational fishing opportunities on the South Fork as well as supplementing the local natural spawning population.

10.2.9.5 VSP Criteria

Abundance **–** The South Fork program has increased the abundance of the combined hatchery-origin and natural-origin components of summer chinook in the upper South Fork., including natural spawners above and below the weir (LSRCP 1998).

Productivity **–** The hatchery program returns a large number of adults and is well above replacement rates. The programs effect on natural productivity is unknown. The longer-term affects of the program on natural production and the efficacy of supplementation as a strategy is being evaluated by the ISS experiment which will not be completed until 2012.

Diversity **–** The South Fork program was originally designed as an integrated program, with inclusion of natural-origin fish and selection of broodstock throughout the run. The program only represents the spawning aggregate upstream from the weir, which is located near the headwater spawning areas. In the mid 1990s the program may have helped preserve remaining diversity in this upstream area when the natural population was at very low abundance. Some of the hatchery fish are known to spawn downstream of the weir and may affect diversity of the downstream spawning aggregate over time as the upper basin fish spawn 1-2 weeks earlier. There will be increased risk to diversity in the future if natural fish are not incorporated into the program and the hatchery stock begin diverging.

Distribution – Prior to the mid 1990s, the program operations appeared to displace spawning fish from productive habitat above the weir and trap on the South Fork, and apparent "drop-out" of fish spawning below the weir was observed . Operational changes including release of supplementation fish above the weir are designed to address the issues of displacement and drop-out (LSRCP 1998). Spawning ground surveys show that spring/summer chinook salmon are widely distributed in the mainstem South Fork (IDFG annual redd count reports) The SBT eyed-egg releases and adult out-plants into under-stocked habitat may have increased distribution and habitat utilization within the South Fork drainage. The increased abundance of both hatchery-origin and natural-origin spawners likely has increased distribution and habitat utilization within the South Fork drainage.

10.2.10 Johnson Creek Program

10.2.10.1 Broodstock History. The Johnson Creek Artificial Propagation Enhancement (JCAPE) project was initiated in 1997 with collection of natural summer chinook adults returning to Johnson Creek as broodstock. The current operation is designed to trap approximately 40 pairs of natural-origin adults returning to a temporary weir on Johnson Creek and produce approximately 100,000 smolts annually from the indigenous stock (NMFS 2004). Natural spawning and escapement is summarized in Table 10.16.

Table 10.16. Estimated naturally-produced adult chinook salmon returns to Johnson Creek from 1997-2002, (from John Gebhards 2002).

Year	Adult Returns
1997	248 (99 redds x 2.5 fpr)
1998	161 (natural fish trapped and carcasses recovered)
1999	60 (24 redds x 2.5 fpr)
2000	185 (natural fish trapped and carcasses recovered)
2001	1282 (natural fish trapped)
2002	795 (natural fish trapped and carcasses recovered)
1997-2002 average	455

10.2.10.2 Similarity between Hatchery-origin and Natural-origin Fish. The entire broodstock are natural-origin fish that are trapped at Johnson Creek. Broodstock is selected to be representative of the run in terms of age and sex ratio and mating protocols are designed to avoid selection and maximize the effective breeding population (NPT 2000). The hatchery component of the population is genetically identical to the naturally spawning component.

10.2.10.3 Program Design. The goal of the JCAPE project is to provide for the maintenance of genetic variability and demographic stability of the Johnson Creek spawning aggregate until such time as the factors responsible for the initial decline are addresses allowing recovery (NPT 2000). There are also recovery and eventually harvest goals if the supplementation program is successful (NPT 1999). The program is designed to collect and artificially spawn up to 40 pairs of adult, natural fish for broodstock, incubate and rear the resulting progeny to smolt stage, and release the smolts back into Johnson Creek where they are expected to return and spawn naturally as adults. For the initial years of the project, all broodstock will be collected from natural fish and all returning hatchery-origin adults will be allowed to spawn naturally (NPT 2000). Broodstock will be collected according to an abundance-based sliding scale designed to ensure natural as well as hatchery broodstock (Table 10.17, NMFS 2004).

Table 10.17. Abundance-based sliding scale for JCAPE broodstock collection.

Number of Adult Returns	Number of Adults Retained for Broodstock	Number of Adults Released for Natural Spawning
<100	Consult with NMFS on collection and release protocols	
100-160	Up to 50% of females and similar number of males	Remainder
>160	Up to 40 pairs, as necessary to produce 100K smolts	Remainder

10.2.10.4 Program Performance. This is a new project, with only one year of completed adult returns from the small number of BY 1998 smolts released in 2000 (Tables 10-18a and b). NPT has an extensive monitoring and evaluation plan that includes the adult trap, juvenile traps, spawning grounds surveys, snorkel surveys and genetic parent:progeny tracing that is expected to provide data on the relative success of the hatchery-origin and natural-origin components of the Johnson Creek population.

Table 10.18a. JCAPE Supplementation Releases and Returns 1998 – 2003; release data (Nelson 2004)**.**

Brood Year [1]	Females Spawned[2]	Males Spawned[2]	Eggs Taken	Eggs Per Female	Eggs Culled	Number Released	% Egg To Release Survival[3]	Release Year
1998	32	17	155,870	4,871	20,477	78,950	58.3	2000
2000	16	33	65,060	4,066	0	57,392	88.2	2002
2001	28	50	107,115	4,119	8,733	73,000	74.2	2003
2002	34	44	166,122	4,885	8,549	14,996[5] 2,542[6] 112,870[7]	96 96.9 83.2	2002 2003 2004
2003	25	28	126,900	5,076	0			

Table 10.18b. JCAPE supplementation Releases and Returns 1998-2003 return data.

Release Year	Males Trapped Age 3	Males Trapped Age 4	Males Trapped Age 5	Females Trapped Age 3	Females Trapped Age 4	Females Trapped Age 5	Total BY Return	% Return (SAR)	Total Adult BY Return	% Adult Return (SAR)
2000	236	233	28	0	159	72	728	0.922	492	0.623
2002	65			0			65[4]	0.113[4]	65[4]	0[4]
2003										
2002 2003 2004										

[1] – No Broodstock was collected in 1999, so no supplementation fish will be documented for that broodyear.
[2] – All male and female broodstock were from wild/natural origin, unless otherwise specified in the report text.
[3] – The number of eggs culled is subtracted from number of eggs taken in calculating egg to smolt survival.
[4] – Incomplete due to brood year not fully returned.
[5] – Eyed egg out-plant on October 22, 2002 of 14,996 eyed eggs.
[6] – Fall Pre-smolt release on October 28 and 29, 2003.
[7] – Brood year 2002 smolt release on March 15 through 18, 2004.

Adult trap numbers indicate that returns to the supplementation program have contributed to natural spawning escapement in the past three years (Table 10.19).

Table 10.19. JCAPE Adult Trap Numbers 1998 – 2003. (Gebhards 2004)

Year	Total Trapped [1]	Number Brood Stock Collected	Number Fish Released Above Weir	Number Supplementation Adults
1998	114	54	60	0
2000	152	73	79	0
2001	1,518	149	1,341	236 [2]
2002	1,192	97	1,085	392 [2]
2003	784	79	691	165 (65 jack, 100 age 5)[3]

[1] – Trap totals include trap morts and stray adults that were removed from Johnson Creek per NOAA Fisheries direction.
[2] – Supplementation adults from brood year 1998 smolt release.
[3] - Supplementation adults from brood years 1998 and 2000 smolt release.

10.2.10.5 VSP Criteria

Abundance – The JCAPE program is achieving program goals of releasing 100,000 smolts of the local stock. Adult return data is very preliminary, but indicates that more adults are returning as a result of the project and the abundance of naturally-spawning chinook in Johnson Creek is greater .

Productivity – The combined productivity of natural-origin and hatchery-origin components is greater than the productivity of natural-origin chinook reported through the 1990s, however, environmental events may have had a large effect on survival during the same time frame the

JCAPE project has operated. Ongoing M&E will describe longer-term trends in productivity and evaluate the effects of the propagation program on population productivity and growth rate. Table 10.20 summarizes a comparison of hatchery-origin and natural-origin productivity for one year class. For this single year class, survival rates and spawner replacement ratios between the two components appear similar.

Table 10.20. Comparison of natural and supplementation broodyear 1998 fish with broodyear 1997 natural fish as a pre-supplementation baseline year. (Vogel 2004)

Life Stage Survival Measure	Broodyear 1997	Broodyear 1998	
	Natural	**Natural**	**Supplementation**
Emigrant to Adult Return Johnson to Johnson	0.97%	1.69%	0.94%
Smolt to Adult Return LGD to Johnson	2.25%	3.60%	2.80%
Adult to Adult Ratio	N/A	8.30	13.70
Adult Female to Adult Female Ratio	N/A	7.30	7.00

<u>Diversity</u> **–** Increased abundance reduces concerns for demographic effects of a very small population size on diversity and genetic integrity. The project is planned with appropriate genetic management and breeding protocols.

<u>Distribution</u> – Increased abundance is expected to distribute fish throughout the available habitat in Johnson Creek. If the project is successful, one of the off-ramps for production in excess of project goals is to release juvenile or adult salmon in the upper reaches of the drainage where habitat is vacant.

10.2.11 Pahsimeroi River Summer Chinook Salmon Program

10.2.11.1 Broodstock History. The spring/summer chinook salmon hatchery program began in 1980, pursuant to a settlement agreement with Idaho Power Company (IPC) as mitigation for the Hells Canyon Hydroelectric Complex on the Snake River (FERC 1980). A steelhead program has operated at this location since 1969, also for IPC mitigation. The hatchery is located on the lower Pahsimeroi River near Ellis, Idaho and the IPC mitigation obligation is 1 million hatchery summer chinook smolts. Prior to 1985, Rapid River and South Fork Salmon River hatchery stocks were imported and used in this program (IDFG 1998). Since then broodstock have been taken entirely from natural and hatchery fish returning to the Pahsimeroi River (IDFG 1998). The hatchery release reached 1 million smolts of the Pahsimeroi River indigenous stock for the first time in 2003**.** Chinook smolts are reared and released from a satellite rearing pond facility located 7 miles above the hatchery weir and trap. The Pahsimeroi Hatchery stock is part of the ESU.

10.2.11.2 Similarity between Hatchery-origin and Natural-origin Fish. Prior to 1985, non local hatchery stocks were imported and released into the Pahsimeroi River. Between 1985 and the ESA listing of this ESU in 1992, broodstock were collected from a combination of hatchery and natural returns. Subsequent to the 1992 listing, IDFG has maintained two groups of hatchery fish. The first group (supplementation component), has remained fully integrated with the natural population by incorporating natural fish into the broodstock. The second group (reserve component), is composed of known hatchery fish whose linage predates the listing and has not incorporated natural fish. The supplementation group has followed the concepts and strategies as defined and outlined in RASP (1992) and Cuenco *et al.* (1993) and is believed to be fully integrated with the natural population. At this time, natural-origin fish are only incorporated into the supplementation group.

Adult trap records indicate that both hatchery-origin and natural-origin adult returns have increased steadily since the 1996 year class. The number of fish passed for natural spawning has increased from fewer than 50 in the mid-1990s to more than 800 in 2003, and the number of hatchery-origin returns have exceeded conservation needs since 2001 (Tables 10.21 and 22).

Table 10.21. Smolt releases and adult returns with SARs for Pahsimeroi Hatchery summer chinook salmon 1983-2004. (Pahsimeroi Hatchery Files)

Release Date	Number	3-year	4-year	5-year	Total	Return Years	Smolt:Adult
MAR 1983	13,690	11	72	30	113	84,85,86	0.825%
APR 1984	55,800	27	278	52	357	85,86,87	0.640%
APR 1985	209,155	37	408	716	1,161	86,87,88	0.555%
MAR 1986	12,095	13	47	31	91	87,88,89	0.752%
MAR 1987	258,600	75	180	42	297	88,89,90	0.115%
MAR 1988	598,500	135	389	79	603	89,90,91	0.101%
MAR 1989	1,016,300	39	139	27	205	90,91,92	0.020%
MAR 1990	1,058,000	20	98	119	237	91,92,93	0.022%
MAR 1991	227,500	6	37	1	44	92,93,94	0.019%
MAR 1992	605,900	13	26	0	39	93,94,95	0.006%
APR 1993	375,000	7	73	8	88	94,95,96	0.023%
APR 1994	130,510	7	27	9	43	95,96,97	0.033%
APR 1995	147,429	5	60	34	99	96,97,98	0.067%
APR 1996	0	0	0	0	0	97,98,99	N/A
APR 1997	122,017	18	207	32	257	98,99,2000	0.211%
APR 1998	65,648	78	259	308	645	99,2000,2001	0.983%
APR 1999	135,669	73	515	256	844	2000,2001,2002	0.622%
APR 2000	53,837	28	360	403	791	2001,2002,2003	1.469%
APR 2001	283,063	308	1072			2002,2003,2004	0.000%
APR 2002	508,340	943				2003,2004,2005	0.000%
MAR 2003	1,205,918					2004,2005,2006	0.000%
APR 2004	1,108,028					2005,2006,2007	0.000%

Table 10.22. Pahsimeroi Hatchery adult summer chinook trapping history 1985 to 2003.

	Total Trapped		Total Marked (HOR)	Total unmarked (NOR)	Total Released		Total Ponded	
	Adults	Jacks			Adults	Jacks	Adults	Jacks
1985	83	27			0	0	85	27
1986	308	37			100	0	208	37
1987	461	13			220	8	241	5
1988	763	75			227	33	536	42
1989	212	135			49	33	163	102
1990	431	39			134	15	297	24
1991	218	20			70	6	148	14
1992	125	6			43	2	82	4
1993	156	13			105	9	51	4
1994	27	9	8	28	27	9	0	0
1995	73	7	65	15	22	5	51	2
1996	79	10	40	49	47	4	32	6
1997	144	2	70	76	69	2	75	0
1998	109	18	52	75	68	11	40	8
1999	288	89	285	92	123	54	165	35
2000	371	88	364	95	77	13	294	11
2001	1,062	35	861	236	296	10	755[1]	25
2002	802	320	924	198	136	6	666[1]	314
2003	1,773	974	2,416	329	721	42	1,052[1]	932
2004[2]	*3,066*	*1,933*	*4,663*	*436*	*792*	*80*	*2,274*	*1,853*

[1]Fish in excess of broodstock needs distributed to food banks and tribal subsistence
[2]Predicted 2004 return

10.2.11.3 Program Design. The Pahsimeroi program is an IPC mitigation program operated by IDFG which was initially designed as a harvest program. The current program design includes both supplementing the natural population and harvest as objectives. The hatchery program and natural population are incorporated into the ISS experiment as a treatment stream (IDFG 1991). The supplementation treatment is being phased out through 2007 as part of the ISS study design. The IDFG will begin managing the program with an emphases on harvest augmentation and isolated from the natural population beginning in BY 2004.

10.2.11.4 Program Performance. In the 1990's smolt-to-adult returns (SARs) were low, as reflected in decreasing populations and low adult returns. Since BY 1996 (released in 1998), smolt-to-adult returns (SARs) have been improving as reflected by the increasing population trend and the program appears to be above replacement (Table 10.21)

10.2.11.5 VSP Criteria

Abundance **–** The Pahsimeroi program has increased the abundance of the combined hatchery-origin and natural-origin components of summer chinook in the Pahsimeroi River, with smolt releases of the local stock reaching 1,000,000 per year in 2003 and 2004, and release of supplemental adults for natural spawning above the weir (IDFG 2004).

Productivity **–** Since BY 1996, hatchery fish have been returning in excess of that required for replacement, however, they were below replacement in some years during the early to mid 1990s. The short and long term effects on natural fish productivity are unknown, however, determining this is one of objectives of the Idaho Supplementation Studies project which will not be completed until 2012.

Diversity **–** Use of imported hatchery stocks prior to 1985 probably affected the diversity of the native Pahsimeroi River summer chinook salmon. The program has operated since then, at least in part, as an integrated program with natural fish. It is unknown what effect the current hatchery program is having on natural fish diversity but the program has attempted to collect adults that represent then entire run. The hatchery program will not collect natural origin adults in 2004, and if the broodstock is managed as a segregated program over the long term it will likely result in divergence of the hatchery fish.

Distribution – The increased abundance of both hatchery-origin and natural-origin spawners may increase distribution and habitat utilization within the Pahsimeroi River drainage.

10.2.12 Upper Salmon River Spring Chinook Salmon Program – Sawtooth Hatchery

10.2.12.1 Broodstock History. The Sawtooth Hatchery is located along the upper Salmon River five miles upstream(south) of Stanley, Idaho. The hatchery was constructed in 1984-85 as part of the LSRCP with an objective of returning 19,445 spring chinook adults above Lower Granite Dam to compensate for anadromous fishery losses due to the construction of the four lower Snake River dams. There is a satellite facility located on the East Fork Salmon River (EFSR). The original production goal was 1.3 million spring chinook salmon smolts from the upper Salmon River for on-station release, 300,000 for release in Valley Creek, and 700,000 smolts of the indigenous EFSR stock for release into the EFSR (IDFG 2002b). Adult chinook were trapped at the Sawtooth Hatchery weir and at the EFSR satellite facility until 1994. The EFSR element of the program was discontinued after 1994, due to poor performance and low run sizes. The spring chinook stock at Sawtooth Hatchery are included in the ESU.

10.2.12.2 Similarity between Hatchery-origin and Natural-origin Fish. Broodstock for the Sawtooth Hatchery program originated primarily from endemic sources in the upper Salmon River. Prior to the construction of Sawtooth Hatchery, chinook salmon smolts of upper Salmon river endemic stock were periodically released at Decker Flats rearing pond in the vicinity of the present hatchery (first records from 1966) (IDFG 1991). Adult salmon were trapped and spawned at temporary facilities located at the Sawtooth site, with incubation and rearing at McCall Hatchery between 1978 and 1982. While locally returning adults were the primary stock released, a few lots of non local Rapid River stock were released during the 1980s, with negligible adult returns (IDFG 1991). The hatchery broodstock were fully integrated with the natural returns prior to the ESA listing. The broodstock collection design was to retain approximately one-third of the natural-origin returns into the hatchery broodstock and release about one-third of the hatchery-origin fish for natural spawning escapement (IDFG 1998). Subsequent to the 1992 listing, the program maintained two groups of hatchery fish. The first group (supplementation component), has remained fully integrated with the natural population by incorporating natural fish into the broodstock and release of hatchery-origin adults for natural spawning at a ratio of 1:1. The second group (reserve component), is composed of known hatchery fish whose linage predates the listing and has not incorporated natural fish. This later group of hatchery fish has used only marked hatchery fish for broodstock for 12 years and some divergence may be occurring. The supplementation group has followed the concepts and strategies as defined and outlined in RASP (1992) and Cuenco *et al.* (1993) and is believed to be fully integrated with the natural population.

10.2.12.3 Program Design. The Sawtooth program was initially designed as a harvest program, but has evolved to also include a supplementation objective. Since listing in 1992, the program has been managed to achieve two objectives; to supplement the upper Salmon River natural population above the hatchery (supplementation group described above) and to provide state and tribal fishing opportunities by producing smolts from known hatchery-by-hatchery crosses (the "reserve" group described above). Some of the reserve group of hatchery fish were allowed to spawn naturally in the mid 1990s when the upper Salmon River natural population was reduced to a critically low abundance. The IDFG is phasing out the supplementation element of this program as part of the ISS experiment (IDFG 2004). Beginning with BY 2004, the entire program will be managed as a harvest augmentation program.

Returns to the hatchery were so low in some broodyears during the late 1990s that all the hatchery and wild fish were consolidated into a single listed broodstock. However, in other years, the segregation of reserve and supplementation groups was maintained. The variable mixture of listed and unlisted components of hatchery-origin fish leads to complex management decisions. For example, of the adult salmon returning to Sawtooth Hatchery in 2004, the BY2001 and BY1999 fish include an unlisted component while the BY 2000 fish are all listed.

10.2.12.4 Program Performance. The Sawtooth program has had a mixed performance. This is likely been influence by the fact that Sawtooth is located 900 miles from the ocean at an elevation of 6,500 feet and smolts have the longest migration of any anadromous fish in the Columbia Basin. In the late 1980s to mid 1990s, hatchery fish were generally returning at less that a 1:1 parent-to-progeny rate. Adult returns to the Sawtooth Hatchery weir declined to only 37 fish in 1995, reflecting very poor smolt-to-adult survival (SAR) survival during the 1992 and 1993 emigration of the 1990 and 1991 broodyears. Since the 1996 release in 1998, SARs have been much higher and adult returns have averaged 1,500 fish per year since 2000, compared to 200 during the decade of the 1990s. This trend is similar for most Snake Basin spring/summer chinook salmon programs during this period. Hatchery fish generally have a higher parent-to-progeny ratio, although there have been some years when the ratio for natural spawners exceeded the ratio for hatchery spawners during the past 2 decades.

Information for juvenile spring chinook salmon released into the upper Salmon River at the Sawtooth Fish Hatchery is presented in Table 10.23.

Table 10.23. Release numbers and SARs for chinook smolts produced at Sawtooth hatchery 1986-2001. SARs are minimums that do not account for out-of-basin harvest or in-basin straying. (IDFG 2002f)

			Return Age From BY				
Brood Year	Number Released	Year Released	1-ocean	2-ocean	3-ocean	Total	SAR (%)
1986	100,600 1,604,900	1987 1988	428	1,410	326	2,164	0.127
1987	990,995 1,101,600	1988 1989	41	199	109	349	0.017
1988	717,400 1,500,200	1989 1990	41	263	481	785	0.035
1989	650,600	1991	15	77	26	118	0.018
1990	1,263,864	1992	29	64	6	99	0.007
1991	774,583	1993	6	15	25	46	0.006
1992	213,830	1994	16	74	26	116	0.054
1993	128,532 205,781	1994 1995	0	79	10	69	0.022
1994	25,006	1996	0	3	4	7	0.028
1995	4,650	1997	0	12	37	49	1.010
1996	43,161	1998	60	135	32	227	0.526
1997	217,336	1999	279	1,219	327	1,825	0.840
1998	123,425	2000	176	531	-	-	-
1999	57,134	2001	65	-	-	-	

The very low SARs for the 1990 and 1991 year classes are reflected in the very low returns of adults in 1995 and weak year classes continued through 1999 (Table 10.24).

Table 10.24. Adult salmon returns to Sawtooth Hatchery rack 1995-2002. Prior to 2002 all hatchery-origin fish were not marked and could not be identified. (IDFG 2002f)

Return Year	Sawtooth Fish Hatchery Total Returns (Hatchery-Produced/Natural)	Total Ponded (H/N)	Total Released (H/N)	Total Male Returns (H/N)	Total Female Returns (H/N)
1995	37 (19/18)	17 (17/0)	20 (2/18)	33 (17/16)	4 (2/2)
1996	156 (51/105)	62 (32/30)	94 (19/75)	118 (34/84)	38 (17/21)
1997	254 (99/155)	142 (92/50)	112 (7/105)	153 (49/104)	101 (50/51)
1998	153 (26/127)	61 (17/44)	92 (9/83)	76 (11/65)	77 (15/62)
1999	196 (75/121)	67 (26/41)	129 (49/80)	161 (66/95)	35 (9/26)
2000	986 (451/535)	461 (408/53)	525 (43/482)	734 (329/405)	252 (122/130)
2001	2,103 (1,427/676)	872 (815/57)	1,231 (612/619)	1,227 (833/394)	876 (594/282)
2002	1,786 (923/863)	446 (377/69)	1,340 (546/794)	884 (368/516)	902 (555/347)

Low returns from the 1992 and 1993 out-migrant years are also reflected in the very small egg takes and smolt releases for BY 1994 and 1995 (Table 9.25).

Table 10.25. Sawtooth Fish Hatchery spring chinook broodyear egg collection and survival information by hatchery life stage, 1998-2001. (IDFG 2002b)

Brood Year	Eyed-Eggs	Number of Fry Ponded to Vats (% survival from eye)	Number of Fingerlings Transferred From Vats to Raceways (% survival from eye)	Number of Smolts Released	Percent Survival From Eyed-Egg to Release
1988	2,846,235	2,818,312 (99.0)	n/a	2,541,500	89.3
1989	668,373	n/a	660,560 (98.8)	652,600	97.6
1990	1,346,350	1,308,098 (97.2)	n/a	1,273,400	94.6
1991	794,800	n/a	n/a	774,583	97.5
1992	423,600	422,093 (99.6)	441,835 (97.2)	213,830	50.5
1993	341,641	338,500 (99.1)	336,424 (98.5)	334,313	97.9
1994	26,232	25,888 (98.7)	25,659 (97.8)	25,006	95.3
1995	4,997	4,890 (97.9)	4,812 (96.3)	4,756	95.2
1996	45,128	44,875 (99.4)	43,650 (96.7)	43,161	95.6
1997	234,000	232,213 (99.2)	225,468 (96.4)	223,240	95.4
1998	129,593	127,064 (98.0)	124,730 (96.2)	123,425	95.2
1999	59,373	59,111 (99.6)	58,114 (97.9)	57,134	96.2
2000	420,733	402,777 (95.7)	398,833 (94.8)	385,761	91.7
2001	1,231,111	1,213,215 (98.5)	1,196,468 (97.2)	n/a	n/a

10.2.12.5 VSP Criteria

Abundance – The Sawtooth Hatchery program has increased the abundance of the combined hatchery-origin and natural-origin components of spring chinook in the upper Salmon River area, including natural spawners above and below the weir (IDFG 2002b).

Productivity – The propagation program has had uncertain affects on the combined population productivity. The longer-term affects of the program on natural production and the efficacy of supplementation as a strategy is being evaluated by the “Idaho Supplementation Studies” project which will not be completed until 2012.

Diversity – Although it has not been measured, the occasional release of Rapid River stock prior to 1985 may have negatively affected historical diversity in the upper Salmon River. The Sawtooth program may have helped preserve remaining diversity in the mid 1990s when natural population abundance declined to very low levels. The supplementation group has been operated as an integrated program, with inclusion of natural-origin fish and selection of broodstock throughout the run. The reserve group has been maintained without incorporating natural fish since listing in 1992, although in some years it has also been used in supplementation during the mid 1990s. Uncertainty over the long term affect on diversity continues to exist. Plans to stop incorporating natural fish into the hatchery broodstock beginning in 2004, is a potential hazard to the long term genetic diversity in the upper Salmon River.

Distribution – The increased abundance of both hatchery-origin and natural-origin spawners is expected to increase distribution into under-utilized habitats in this subbasin. Proposed eyed-egg releases and adult out-plants into under-stocked habitat may provide increased distribution and habitat utilization within the upper Salmon River drainage, but they may also risk introgression with other local population components..

10.2.13 IDFG Captive Rearing Experiments (Lemhi, East Fork and WF Yankee Fork Spring Chinook Salmon Program)

10.2.13.1 Broodstock History. In 1994 and 1995, natural salmon populations had declined to very low abundance in many areas of the Snake River. Managers throughout the Snake River were actively considering alternatives for intervention with artificial propagation to preserve genetic resources. The 1995 NOAA Fisheries’ Proposed Recovery Plan (NMFS 1995) identified artificial propagation as appropriate conservation measure to promote recovery in some cases. As Snake River chinook salmon populations declined to critical low numbers in 1994 and 1995, fishery managers convened to discuss possible means of maintaining the overall stock structure of the Snake River chinook salmon population. Little scientific information existed at that time on captive culture techniques for Pacific salmon. Flagg and Mahnken (1995) were developing a review of captive brood stock technology, and Joyce *et al.* (1994) had discussed rearing chinook salmon to maturity in captivity. As a result of the discussions and review of available scientific information, Snake River fishery managers agreed to test the utility of captive culture for preservation of listed salmon. While ODFW chose a captive broodstock and conventional smolt production strategy (see Grande Ronde discussion above), IDFG chose a strategy of captive rearing (IDFG 2002c). The captive rearing experiment consists of collecting juvenile salmon or eyed eggs from targeted streams, rearing the resulting fish to adulthood in captivity, and releasing the adults to spawn naturally when they reach maturity.

Idaho initiated the captive rearing program for the Lemhi River, East Fork Salmon River, and

West Fork Yankee Fork spring chinook salmon populations. The program was initiated in 1995 with the collection of BY 1994 parr. The objective of the initial project was maintaining a minimum spawning population of 20 adults in the 3 targeted streams (IDFG 1995). The three populations selected were at very low abundance and at risk of extirpation. There is a robust monitoring and evaluation element to the program with the intent of developing techniques for producing a captive reared adult that would successfully reproduce in nature and assessing the actual success of the experiment. The program is operated by IDFG with the Shoshone-Bannock Tribes as a cooperator and funded by BPA.

10.2.13.2 Similarity between Hatchery-origin and Natural-origin Fish. The Lemhi, East Fork and WF Yankee Fork Spring Chinook Salmon captive rearing program uses only naturally-spawned, eyed eggs from local, indigenous fish. The captive reared fish are thought to be genetically equivalent of their siblings that mature in the wild.

10.2.13.3 Program Design. The Lemhi, East Fork and WF Yankee Fork Spring Chinook Salmon captive rearing program was designed both as an emergency response to very low population sizes and as an experiment to test one of several captive propagation strategies (Flagg and Mahnken 1995, Pollard and Flagg, in press) as potential tools to aid in recovery and conservation of listed anadromous salmon. It has operated within that experimental design.

10.2.13.4 Program Performance. The Lemhi, East Fork and WF Yankee Fork Spring Chinook Salmon captive rearing program has been successful in rearing wild fish to maturity in captivity and producing viable eggs. However, there have been numerous problems with synchronization of maturity, spawn timing, and behavior in comparison with the natural salmon resulting in limited success at natural reproduction by captive-reared fish (David Venditti, IDFG project leader, personal communication). The captive reared fish have been artificially spawned and eyed eggs have been returned to the natal streams in in-stream incubators installed and maintained by the Shoshone-Bannock tribal fisheries department. Naturally produced spawning escapement in the three target streams has been in excess of the 20-fish threshold since 1995, which has relieved the emergency nature of the original project (CSCPTOC 2004). The current emphasis of this project is development of captive rearing technology and evaluation of spawning success and survival of eyed egg releases (IDFG 2002c).

10.2.13.5 VSP Criteria

Abundance **–** The Lemhi, East Fork and WF Yankee Fork Spring Chinook Salmon captive rearing program have had no measured impact on the abundance of target populations. Up to 200 juvenile salmon or 500 eggs have been removed annually from each natural population. A few dozen mature fish have been released to spawn naturally and a few thousand eyed eggs have been released. Ongoing monitoring has yet to show whether there has been any contribution to abundance in the targeted streams (CSPCTOC 2004).

Productivity **–** Given the small number of eggs and/or juveniles collected each year, it is unlikely that there has been a measurable negative affect on natural productivity, but neither has there been a measurable positive affect on productivity from the small number of live fish and embryos that have been released back to the source streams.

Diversity – Given the small number of eggs and/or juveniles collected each year, it is unlikely that diversity of the targeted natural populations has been affected in any measurable way. It is uncertain that the programs are having any impact.

Distribution – Given the small number of eggs and/or juveniles collected each year, it is unlikely that the experimental captive rearing programs have had any measurable affect on the targeted populations.

10.3 CONCLUSIONS

Existing Status: Threatened
BRT Finding: Threatened
Recommendation: Threatened

10.3.1 ESU Overview

10.3.1.1 History of Populations

The original number of Snake River spring/summer chinook salmon populations once present in this ESU is uncertain. Spring/summer chinook salmon were extirpated in the Clearwater River basin and tributaries upstream from Hells Canyon Dam on the Snake River. It is unknown whether these extirpated populations were part of this ESU or were ESUs of their own.

The Interior Columbia Technical Review Team has identified 31 remaining populations (see Table 10.1 above).

10.3.1.2 Association between Natural Populations and Artificial Propagation

Natural populations "with minimal genetic contribution from hatchery fish"
Sixteen of 31 listed populations in this ESU do not currently have direct genetic influence from hatchery-origin fish. In most cases, the natural populations have no record of hatchery-origin releases. Artificial propagation programs are associated with 15 populations, 14 of which are derived from local sources and one uses fish not included in the ESU.

Natural[1] populations "that are stable or increasing, are spawning in the wild, and have adequate spawning and rearing habitat" [2]

Index counts for 17 natural production areas indicate populations are persisting but at reduced levels. The natural production areas are; Asotin Creek, Wenaha River, Minam River, Secesh River, Chamberlain Creek, Big Creek, Middle Fork below Indian Creek, Camas Creek, Loon Creek, Pistol Creek, Sulphur Creek, Bear Valley Creek, Marsh Creek, Middle Fork above Indian Creek, North Fork Salmon River, upper Salmon River below Redfish Lake Creek, and Valley Creek..

Mixed (Integrated Programs[3])

There are 14 integrated hatchery programs within this ESU. They include the Tucannon, Lookingglass, Catherine Creek, Lostine, upper Grande Ronde, Imnaha (including Big Sheep Creek), South Fork Salmon, Johnson Creek, Pahsimeroi, and Sawtooth Hatchery programs and captive rearing experiments in the Lemhi, East Fork Salmon and Yankee Fork.

Hatchery (Isolated[4])

Rapid River Hatchery located in the Little Salmon River subbasin is the only program operated as an isolated propagation program.

10.3.2. Summary of ESU Viability

Abundance

The BRT assigned moderate to high risk for Abundance (BRT 2003). See Results section for summaries of abundance information for individual populations.

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[1] See HLP for definition of natural, mixed and hatchery populations

[2] HLP Point 3

[3] Integrated programs follow practices designed to promote and protect genetic diversity and only use fish from the same local population for broodstock (both natural-origin fish, whenever possible, and hatchery-origin fish derived from the same local population and included in the ESU). Programs operated to protect genetic diversity in the absence of natural-origin fish (e.g., captive broodstock programs and the reintroduction of fish into vacant habitat) are considered "integrated".

[4] Isolated programs do not follow practices designed to promote or protect genetic diversity. Fish that are reproductively isolated are more likely to diverge genetically from natural populations included in the ESU and to be excluded themselves from the ESU.

Natural spring/summer chinook salmon annual counts at the uppermost dam have ranged from 17,000 to 38,800 since 2001, compared to fewer than 2,000 in the mid-1990s (JCRMS, 2004) and 65,000 during the early 1960s when dam counts were first recorded. Individual index counts reflect the overall increase in abundance in this ESU that began in 2001, with recent counts averaging about one-third the historic baseline. The 1990s counts were less than one-tenth the baseline numbers (IDFG redd reports). In most cases, integrated hatchery programs have increased the total abundance of the ESU by releasing four to five million smolts each year from stocks that are included in the ESU. In recent years these releases have produced 10 to 40 thousand adults, many of which contribute to natural production (see Results section).

Productivity

The BRT assigned moderate to high risk for Productivity (BRT 2003). See Results section for summaries of productivity information for individual populations. All of the hatchery programs have been above replacement rates since brood year 1996, compared to below replacement earlier in the 1990's. Most natural populations mirror this hatchery trend. It is unknown what effect hatchery programs have had on natural fish productivity.

Spatial Structure

The BRT assigned low to moderate risk to this ESU regarding Spatial Structure (BRT 2003). The low risk rating regarding Spatial Structure reflects the continued broad distribution of natural populations throughout the ESU. Hatchery programs have contributed positively to distribution by helping to seed vacant habitat.

Diversity

The BRT assigned low to moderate risk to this ESU regarding Diversity, based on the persistence of natural populations well distributed throughout the ESU in natural population reserves (BRT 2003). Propagation programs are thought to have helped preserve some of the remaining diversity in this ESU when individual populations declined to very low numbers in 1994 and 1995. Fourteen of the 15 hatchery programs are integrated with natural populations. The single isolated program (Rapid River Hatchery) appears to be successfully isolated, however, early operations appear to have resulted in replacement of the natural population with one genetically similar to the hatchery stock.

10.3.3 Artificial Propagation Record

Experience with Integrated Programs

Most integrated hatchery programs in the Snake Basin are linked to the Lower Snake River Compensation Plan which was authorized by Congress in 1976. The first facility on-line was McCall Hatchery in 1980 (although the egg-bank program started in 1978). These facilities were initially developed as mitigation programs with some changes in goals and stocks after Snake River spring/summer chinook were listed in 1992. The programs have operated for 20 to 25 years with the past ten years focused on conservation and recovery of the listed ESU.

Are Integrated Programs Self-Sustaining

Individual program records indicate that all of the integrated hatcheries suffered a period of very low returns and adult numbers far below replacement, particularly between 1990 and 1997. Since BY 1996, most programs have met egg take goals in most years and several are producing fish in excess of conservation needs allowing limited Tribal and recreational harvest.

Certainty that Integrated Programs will Continue to Operate

Snake Basin hatchery programs are believed to have high certainty of continuing into the future. The Bonneville Power Administration provides funding to the USFWS for the LSRCP (a program mandated by Congress) while the Idaho Power Company (IPC) also is required to provide funding as a license condition for their hydroelectric projects. Each of the propagation programs in this ESU have long-term agreements and stable funding. Monitoring and evaluation supporting effective adaptive management are strengths of these propagation programs.

10.3.4 Summary of Overall Extinction Risk Faced by the ESU:

No populations in this ESU are in immediate risk of extinction. Although some populations are persisting at low abundance, they have demonstrated some resilience and increased abundance since 2001. Total returns of fish included in the ESU, and returns of natural-origin fish only, have increased since 2001 (see Table 10.3). Total dam counts and index counts are still low compared to baseline surveys in the 1950s and 1960s and there are large areas of suitable habitat that are under stocked. Actual abundance in this ESU is confounded by the fact that a high, but unknown proportion of hatchery and natural fish (returning to the Clearwater Basin) are not part the ESU and can not be separated out with any accuracy when counted at Lower Granite Dam. Smolt-to-adult survival and parent replacement ratios for natural populations are low, relative to the survival rates necessary to provide for recovery of this ESU. Artificial propagation programs that follow appropriate conservation practices help maintain the abundance and protect the diversity and spatial structure of this ESU.

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